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U1S S1140 S1839

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GB 1500102 A

(58) Field of Search

UK CL (Edition O) H2E EDCK EDLC E140

INT CL⁶ H01R

(54) Electrical connector housing assembly with readily removable insert

(57) An electrical connector (14) comprises a housing assembly (32) consisting of forward and rear housing sections (138, 140) and a spacer section (142) therebetween, which are secured together in juxtaposed abutting relationship to define a through opening (48). An insert (52) containing electrical terminals therein is secured in the opening (48) by means of resilient clip (65) having inwardly inclined locking lances (67) engaging a peripheral flange (62) of the insert (52). The insert (52) is introduced into the opening (48) by way of the rear housing section (140) and forward movement of the clip (65) is prevented by a shoulder (158) of the forward housing section (138). The opening (48) in the rear housing section (140) is large enough to allow tooling to be inserted to release the locking lances (67) from the flange (62) of the insert (52) so that the insert can be withdrawn from the housing assembly (32) for repair or replacement. The housing assembly (32) is detachable from the remainder of the connector (14), as a single unit to allow the tooling access to the locking lances (67). (Figures 1, 3 and 12).

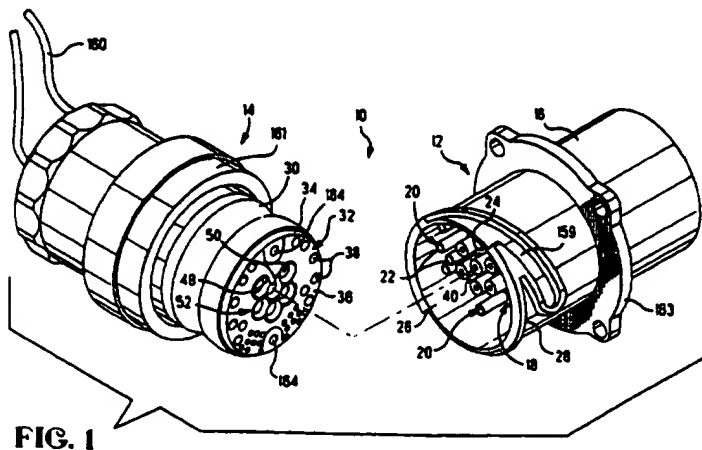


FIG. 1

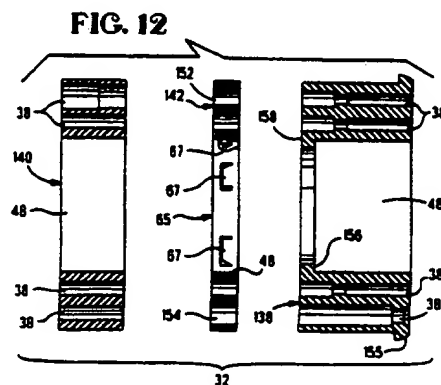
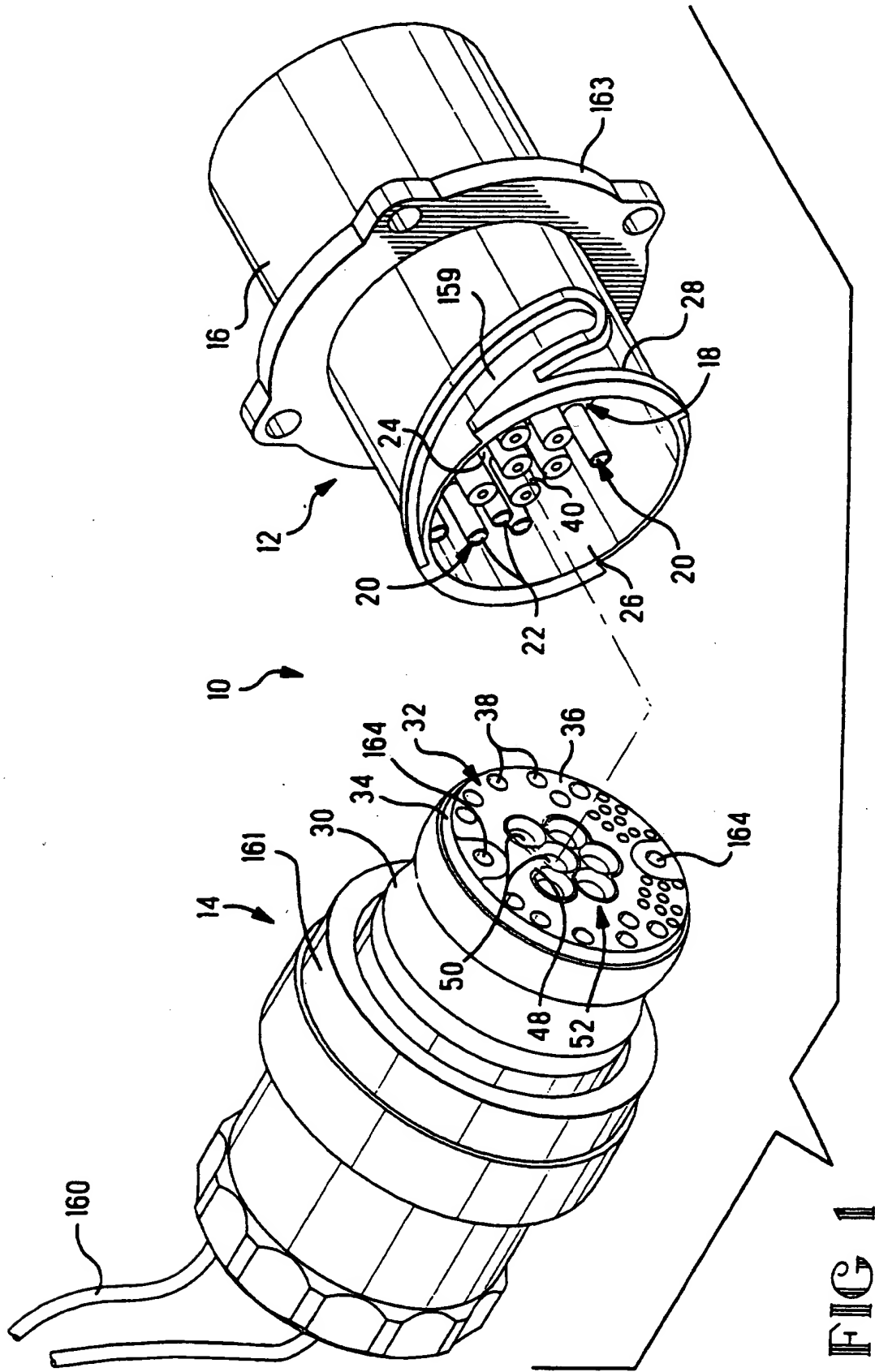


FIG. 12

GB 2 299 465



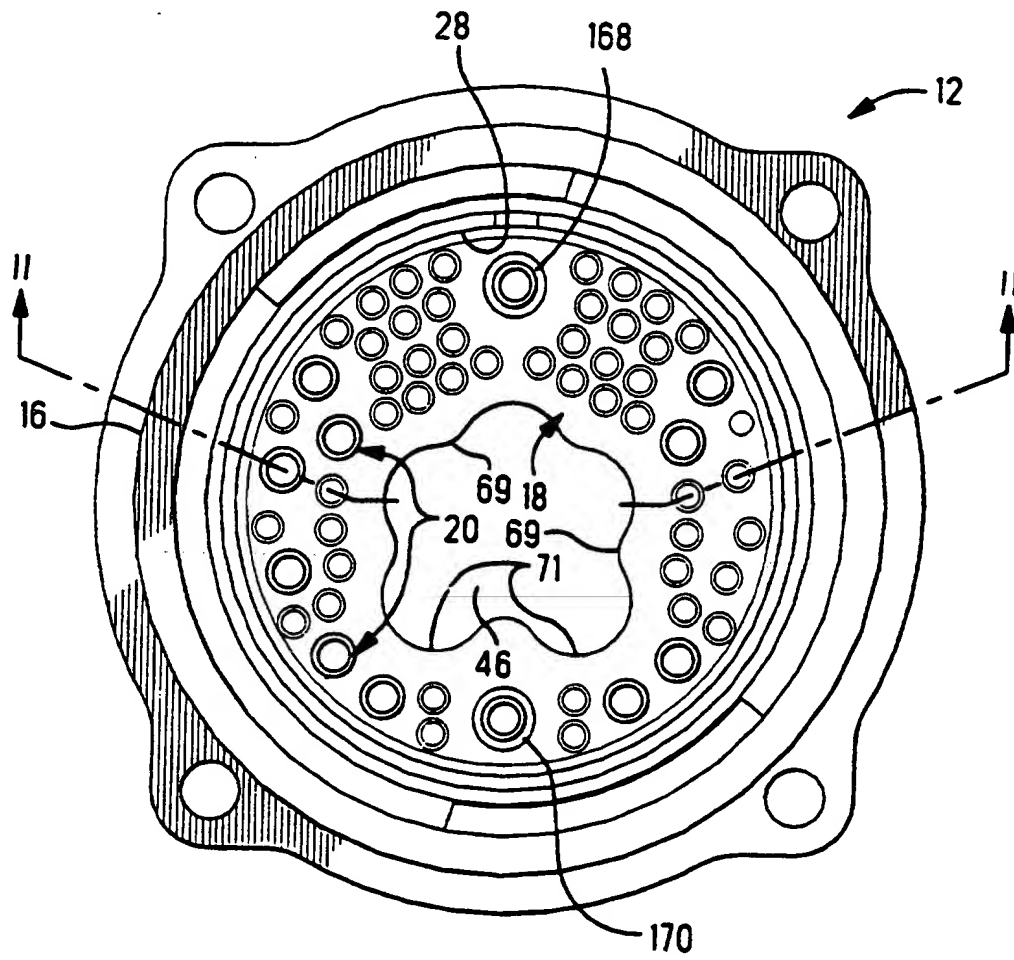


FIG. 2

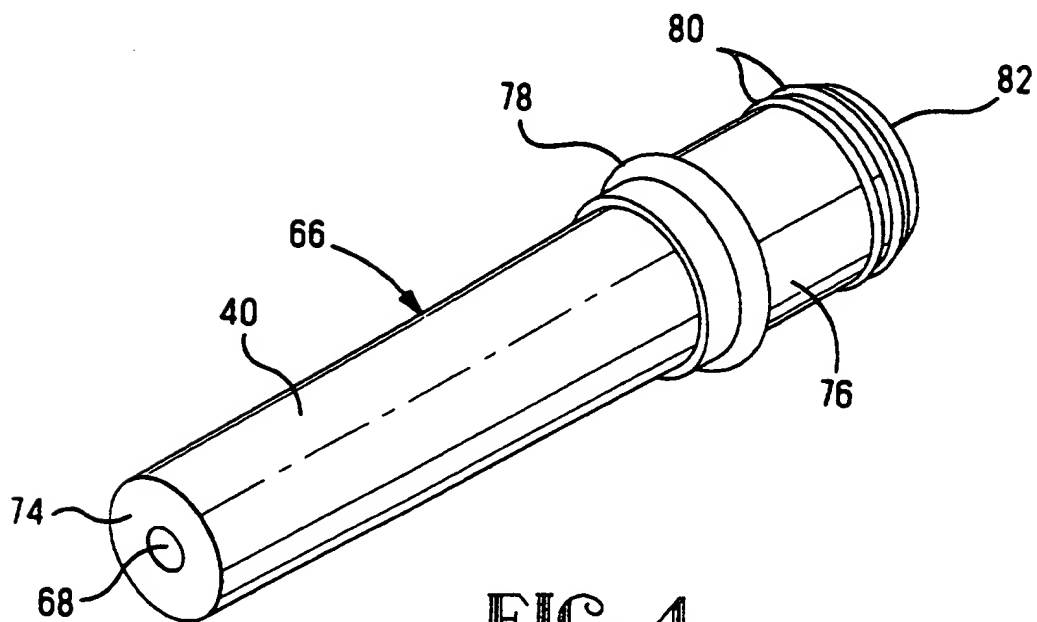
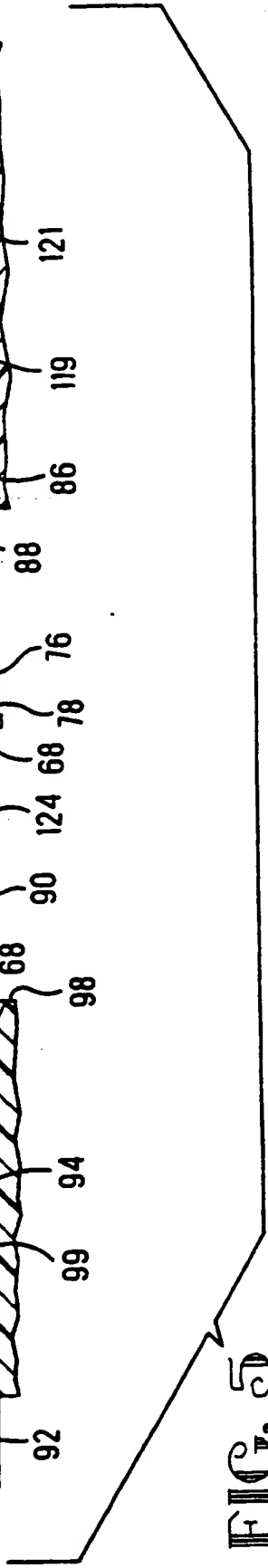


FIG. 4



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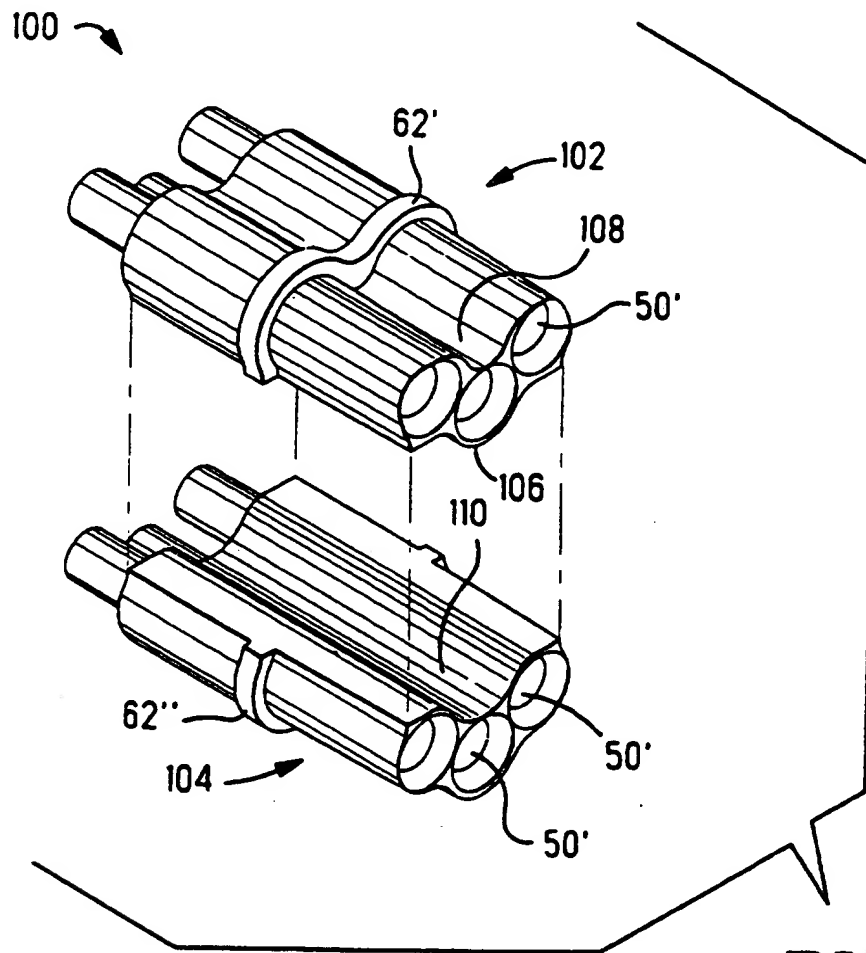


FIG. 7

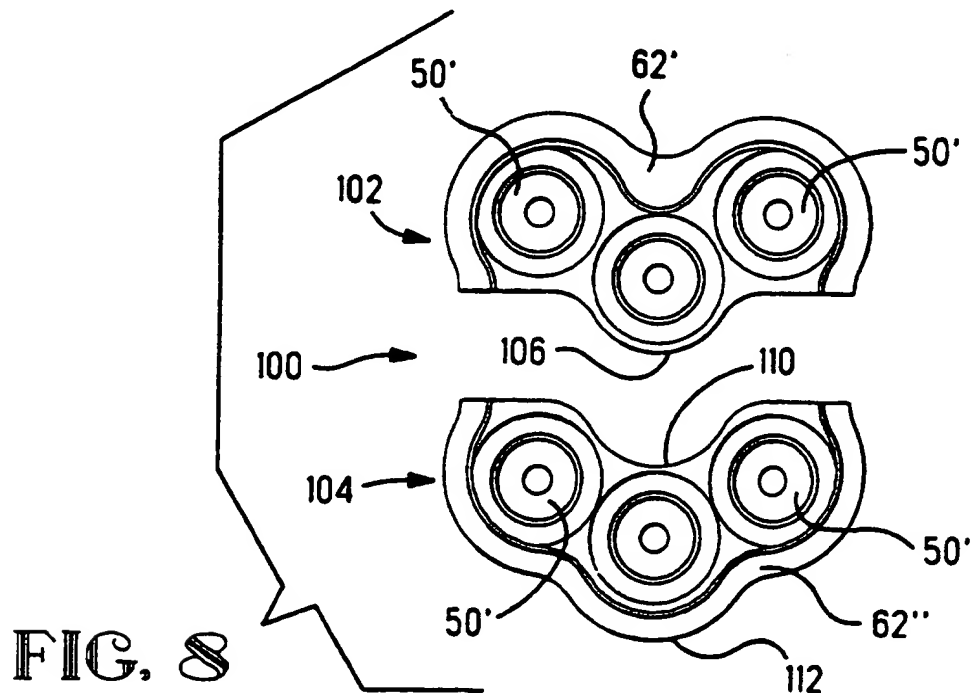


FIG. 8

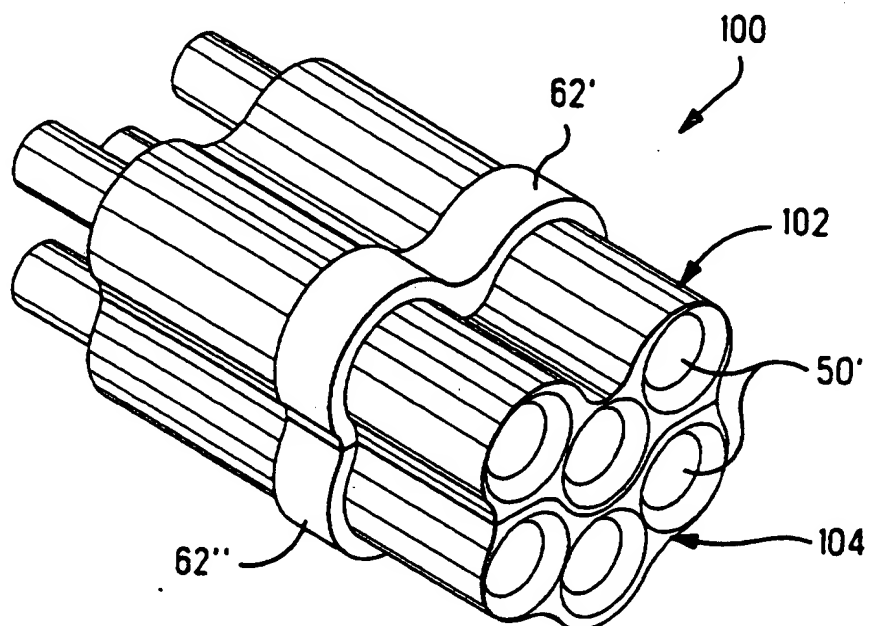


FIG. 9

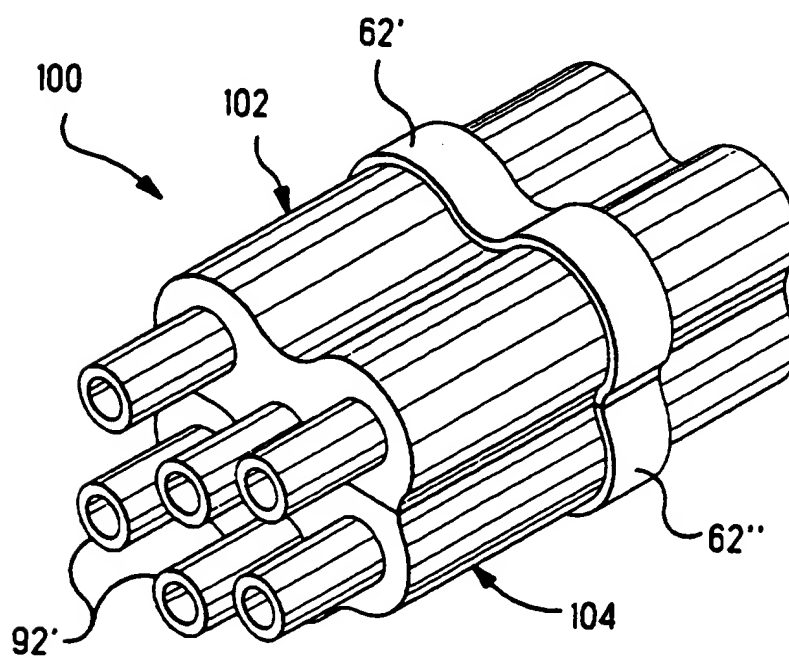


FIG. 10

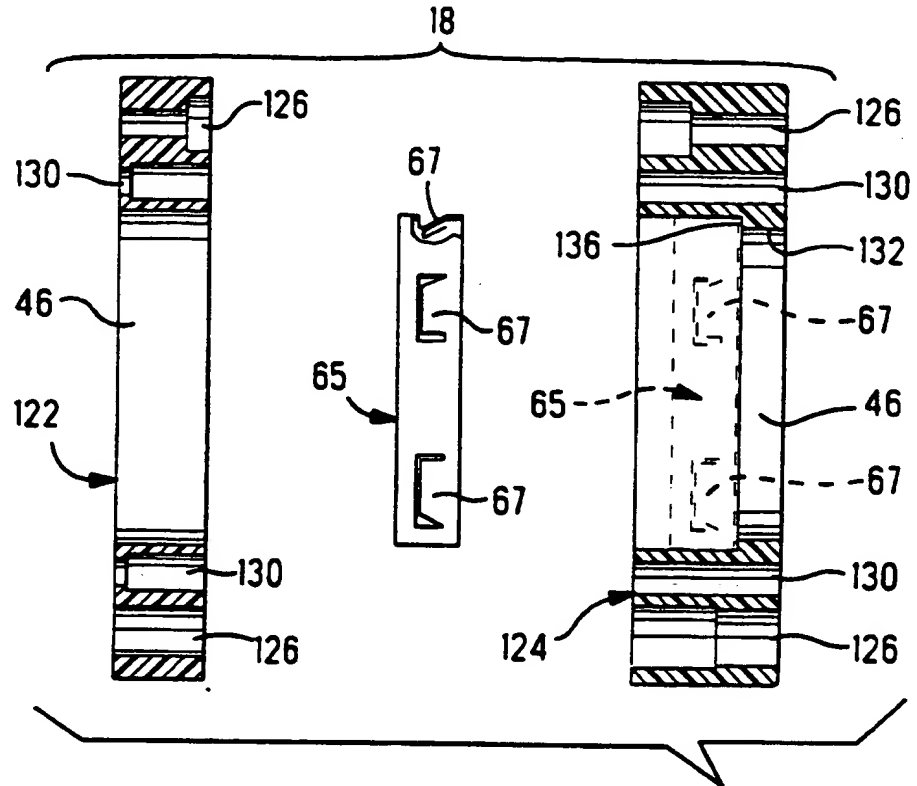
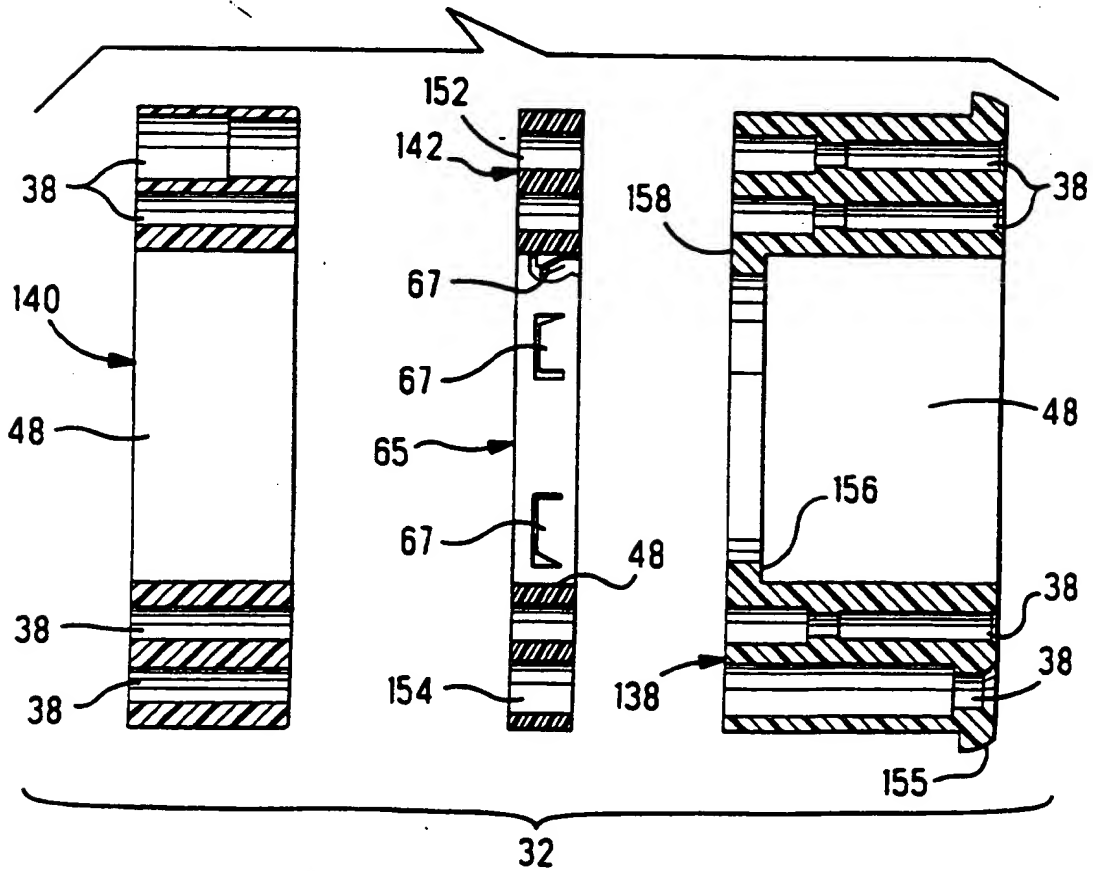


FIG. 11

FIG. 12



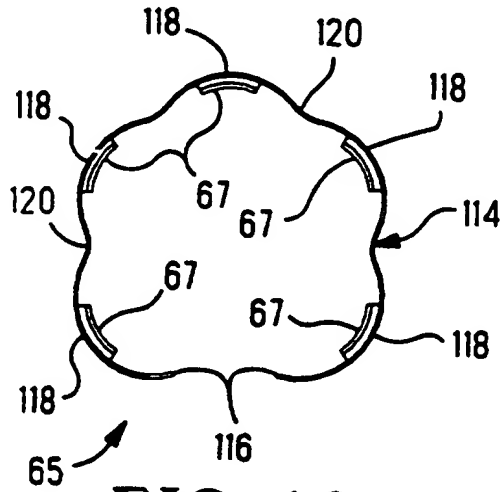


FIG. 13

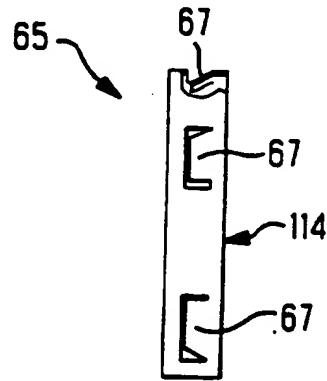


FIG. 14

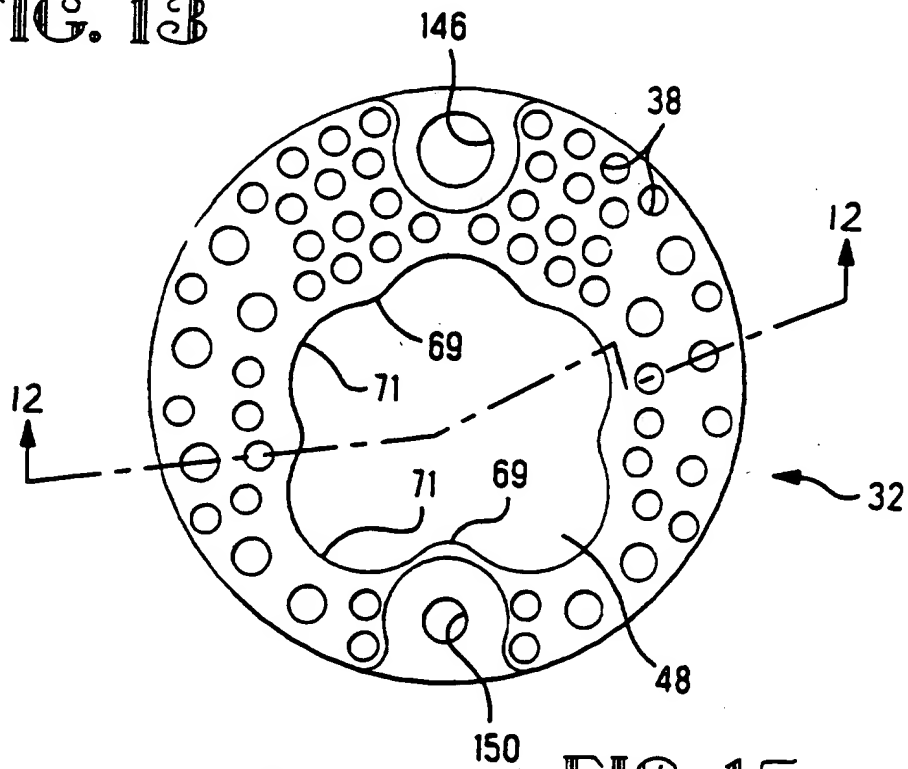


FIG. 15

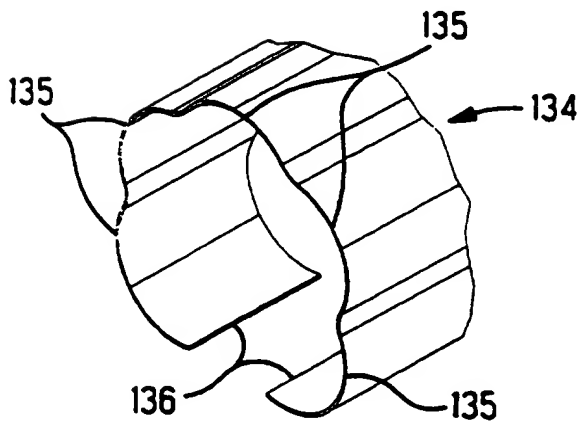


FIG. 16

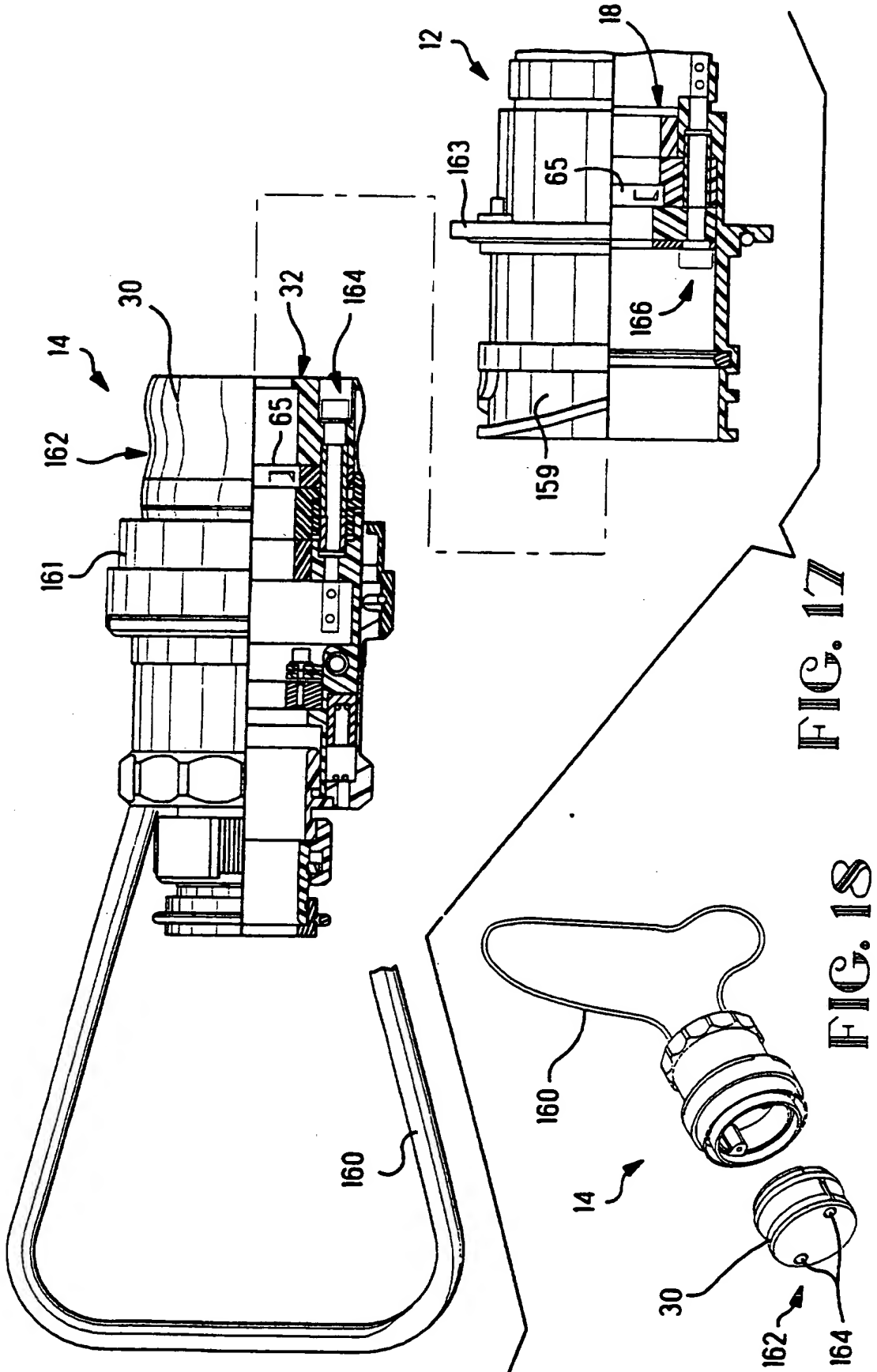


FIG. 17

FIG. 18

ELECTRICAL CONNECTOR HOUSING ASSEMBLY WITH READILY
REMOVABLE INSERT

5 This invention relates to an electrical connector
housing assembly having a forward mating face and a rear
face opposite thereto, and defining an opening extending
between, and opening into, each of said faces, and an
insert for retention in the opening and containing at
10 least one electrical terminal extending through the insert
and having a mating forward section and a rear section for
connection to an electrical conductor.

 Such a connector housing assembly may, for example,
be comprised in each connector of a breakaway electrical
connector assembly in which mating connectors are retained
15 in mating relationship by means of screw threads thereon
and which comprises a breakaway mechanism which is
actuatable to release the connectors from one another. Such
a breakaway connector assembly may be used, for example,
to supply power and data through the helmet of an aircraft
20 pilot, the breakaway mechanism being automatically
actuatable in an emergency, for example, if the pilot needs
to eject from the aircraft. In such a breakaway connector,
each insert will usually comprise a substantial number of
electrical terminals, for example, six electrical
25 terminals, the insert being provided with means for
sealing the terminals against the ingress of moisture.
Especially in the above application the insert should be
readily removable from each housing assembly for repair or
replacement in order to ensure the integrity of the
30 electrical connections provided by the inserts.

 The present invention accordingly consists in an
electrical connector housing assembly having a forward
mating face and rear face opposite thereto, and defining
an opening extending therebetween, and opening into, each
35 of said faces; an insert for insertion in said opening in

an insertion direction and containing at least one electrical terminal extending through the insert and having a mating forward section and a rear section for connection to an electrical conductor; and a retention
5 clip dimensioned to surround said insert and resiliently to engage the wall of the opening; the housing assembly defining a shoulder in said opening for restraining movement of the retention clip in the insertion direction and the retention clip having internally projecting
10 locking lances each for engaging a flange on the insert to retain it in the opening and each being deflectable to release the insert for withdrawal from the opening.

By virtue of the invention, the insert can readily be removed for replacement or repair simply by inserting a
15 tool through the opening to deflect the locking lances.

The retention clip is preferably in the form of a spring metal loop having free ends. Such a retention clip can be resiliently compressed for reception in the opening so as to open out as it is being lodged in the
20 opening.

The opening preferably has an enlarged cross section part for receiving the tool.

For convenience of manufacture, the housing assembly preferably comprises a plurality of housing sections each
25 defining a respective part of the opening, the housing sections having bores for receiving fasteners to secure the housing sections together in juxtaposed relationship. One of the housing sections may define enlarged part of the opening and a part of the opening of smaller cross
30 section whereby the one housing section defines the shoulder for abutment by the clip.

The housing assembly may comprise forward and rear housing sections and a spacer housing section therebetween, the clip being received in the spacer
35 section and the forward housing section presenting the

shoulder. The locking lances of the clip are forwardly inclined, the tool being introduced through the rearward housing section, the part of the opening therein being large enough to accept the tool.

5 In some cases, the clip may be inaccessible to a tool when the housing assembly has been assembled to the connector. In such case, therefore, the housing assembly is formed as a single unit which is detachable from the remainder of the connector to allow access to the clip for
10 exchange or repair of the insert.

 The insert is preferably comprised of a plurality of insert modules which are nested together and each module containing one or more electrical terminals. Thus individual modules can be removed for replacement or
15 repair.

 Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings in which;

 Figure 1 is an exploded isometric view of a breakaway
20 electrical connector assembly comprising mating plug and receptacle electrical connectors containing inserts for high voltage low current electrical connections;

 Figure 2 is a front view of the receptacle connector of Figure 1 illustrating an opening therein for receiving
25 an insert;

 Figure 3 is an exploded isometric view of mating inserts of the connectors;

 Figure 4 is an isometric view of an elastomeric seal member of the receptacle connector;

30 Figure 5 is an exploded, fragmentary, longitudinal sectional view of a high voltage terminal site, comprising the inserts and the elastomeric seal member;

 Figure 6 is a fragmentary longitudinal sectional view showing the parts of Figure 5 assembled with the terminals
35 and mated;

Figure 7 is an isometric view of two three-position high voltage insert modules for nesting together to provide a six-position high voltage insert;

5 Figure 8 is a rear end view of the modules for Figure 7;

Figures 9 and 10 are isometric views showing the insert modules of Figures 7 and 8 nested together;

10 Figure 11 is an exploded axial sectional view taken on the lines 11-11 of Figure 2, of an insulating housing assembly of the receptacle connector;

Figure 12 is an exploded axial sectional view taken on the lines 12-12 of Figure 15, of an insulating housing assembly of the plug connector;

15 Figure 13 is a front elevational view of a clip for retaining inserts in the housing assemblies of Figures 11 and 12;

Figure 14 is a side view of the clip of Figure 13;

Figure 15 is a rear view of the housing of Figure 12;

20 Figure 16 is a fragmentary isometric view of an insert extraction tool;

Figure 17 is an exploded side view, shown partly in section and with parts omitted, of the breakaway electrical connector assembly; and

25 Figure 18 is an isometric view, drawn to a smaller scale than Figure 17, of the connector assembly of Figure 17, showing a unit separated therefrom.

A circular cross section breakaway electrical connector assembly 10 comprises, as shown in Figure 1, a receptacle connector 12 and a plug connector 14 which is
30 mateable therewith. The connector 12 is an assembly comprising a protective shell 16 of durable material, for example metal, and a housing assembly 18 of substantially rigid dielectric material mounted within the shell 16 and through which extend socket terminals 20. The terminals
35 20 have socket contact sections 22 extending forwardly

from a mating face 24 of the connector 12 into a plug receiving cavity 26 defined by a shroud 28 comprised of the forward part of the shell 16. The plug connector 14 is an assembly comprising a protective cylindrical shell 30 of durable material, for example metal, a housing assembly 32 of substantially rigid dielectric material mounted within the shell 30 and including a forwardly extending plug portion 34. The housing assembly 32 includes pin contacts (not shown) recessed back from a mating face 36, in respective passageways 38. During mating of the connectors 12 and 14, the socket contact sections 22 enter the passageways 38 and mate with the pin contacts therein. The housing assemblies 18 and 32 are, according to the embodiment described herein, composed of forward and rear housing sections secured within the respective shells 16 and 30, as will be described in detail below. A central through opening 46 (Figure 2) in the mating face 24 of the receptacle connector 12 receives an insert, described below, from which project forwardly, six silos 40 within the shroud 28. Within each silo 40 is disposed a socket contact section 42 of a socket terminal 44 (Figures 5 and 6). Correspondingly, in a central through opening 48 in the mating face 36 of the plug connector 14 is a further insert, described below, having an array of six silo receiving recesses 50 adapted to receive respective silos 40 of the receptacle connector 12 as the connectors 12 and 14 are mated.

As shown in Figure 3, the silo receiving recesses 50 are defined by a 6position insert 52 disposed within a central through opening 48 of the plug connector 14. The silos 40 are portions of a 6-position insert 54 disposed within the central opening 46. Within each silo receiving recess 50 is a pin contact section 56 of a pin terminal 58, as shown in Figure 6. The inserts 52 and 54 constitute a high voltage low current electrical connector

providing protection against undesired voltage leakage and the generation of corona during the transmission of high voltage low current signals. According to an embodiment described below, the inserts may be constructed in modular form so that the modules can be individually replaced or repaired.

As shown in Figures 5 and 6, the insert 54 comprises a moulded dielectric body 60 encircled by a peripheral flange portion 62 spaced from the leading end 64 of the body 60. The flange portion 62 is positioned in the opening 46 of the housing assembly 18 and is engaged by a retention clip 65 having inwardly directed locking lances 67 to retain the insert 54 in the opening 46, as described in detail below. The insert 52 has a similar flange portion 62 for engagement by a similar retention clip 65 to retain the insert 52 in the opening 48 of the plug housing assembly 32, also as described below. Each of the openings 46 and 48 is configured with alternating, longitudinally extending nodes 69 and troughs 71, thereby to conform with the peripheral shape of the respective insert.

The silos 40 are forward portions of seal members 66 moulded from elastomeric material, for example, silicone rubber, a material commonly used in high voltage connectors. Each seal member 66 is associated with a particular socket terminal 44 (Figure 6) in a passageway 68 of the member 66, with a socket contact section 70 of the terminal 44 within the silo 40 so that the leading end 72 of the section 70 is recessed back from the leading end 74 of the silo 40, as shown in Figure 6. The seal member 66 also includes a rear body portion 76 and an annular embossment 78 spaced rearwardly of the silo 40. The seal member 66 further includes a pair of very small embossments 80 proximate to the rearward end thereof. As shown in Figure 5, the longitudinal sectional views of the

inserts 52 and 54 and of the elastomeric seal member 66 show passageways therein for receiving the respective socket and pin terminals 44, 58. The seal member 66 has a passageway 68 having a reduced diameter portion defined by an internal annular embossment 84 to grip the socket terminal 44 upon assembly thereof. An annular flange 82 is positioned at the rear end of the silo 40 to extend along, and against, the adjacent portions of the forward surface 64 of the insert 54. The flange 82 effectively closes off the entrance to a forward aperture 86 of the insert 54 into which the body portion 76 of the seal member 60 is inserted during assembly. Where a lead in to the silo recess 50 is not provided to facilitate blind mating of the silos 40 in the respective recesses 50, the flange is useful to provide a seal between the facing surfaces 64 and 98 of the inserts 52 and 54, upon full mating thereof, about the mated terminals. Overcompression of the flange 82 between the surfaces 64 and 98 should be avoided in order to prevent damage to the seal member 66.

In the aperture 86 of the insert 54 is an annular groove 88 proximate to the leading end 64 of the insert body 60. The groove 88 acts as a seat for the embossment 78 of the seal member 66, during assembly. The silo 40 has, opening into its leading end 74, a reduced diameter passageway 90 disposed forwardly of the leading end of the socket contact section 42. The passageway portion 90 has an inner diameter just large enough to receive the respective mating pin contact section 56 for mating with the respective socket contact section 42. The silo receiving recess 50 is an enlarged diameter forward portion of a passageway 92 of the insert 52, with a reduced diameter portion 94 providing a forwardly facing shoulder 96 defining the bottom of the silo receiving recess 50. The depth of the silo receiving recess 50 is

selected to be less than the length of the silo 40 to be received in the recess 50. The silo 40 is thereby longitudinally compressed below the recess 50 when the connectors 12 and 14 have been fully mated and portions of the forward surface 98 of the insert 52 are adjacent to the forward surface 64 of the insert 54 at the rearward end of the silo 40. A larger cross section passageway portion 99 disposed rearwardly of the reduced diameter portion 94 receives a body portion 97 of a respective pin terminal 58.

A pin terminal 58 is shown in Figure 6 as having been disposed in the passageway 92 of the insert 52 with the body portion 97 of the pin terminal disposed in the passageway portion 99 and a rearward termination section 101 of the terminal 58 terminated to a conductor in a respective high voltage cable 103, for example, by crimping.

Preferably the termination section 101 of the pin terminal 58 and adjacent portions of the cable conductor are coated with a silicone rubber adhesive prior to insertion into the insert 52 to establish a bond for securing the body portion 97 in the passageway portion 99. The terminal 58 should be held carefully centred within the slightly larger passageway portion until the adhesive has cured. A length of heat recoverable tubing 105 is preferably shrunk about a tubular flange 107 extending rearwardly from the insert 52 and about the adjacent part of the insulation of the high voltage cable 103. The seal member 66 having been assembled into the aperture 86 of the insert 54 by an interference fit, the annular embossment 78 is seated within the annular groove 88. A socket terminal 44 is disposed in the passageway 68 of the seal member 66 to extend through the aperture 86 of the insert 54, with a body portion 111 of the terminal 44 gripped tightly at the annular embossment 84 which is

radially expanded during the insertion of the terminal 44. A rearward termination section 113 of the terminal 44 is terminated to a conductor of a respective high voltage cable 115, for example, by crimping. Preferably, the socket terminal 44, includes an annular collar 117 adapted to abut a rearwardly facing shoulder 119 in a passageway 121 of the insert 54. Shoulder 119 serves as a positive stop during the insertion of the socket terminal 44 into the passageway 121 after being crimped to the cable conductor of the cable 115. A length of heat recoverable tubing 105 is preferably shrunk about a tubular flange 109 extending rearwardly from the insert 54, and the adjacent part of the insulation of the high voltage cable 115. The angle of taper of the silo 40 may be about 0.2 degrees and the angle of taper of the recess 50 may be about 1.31 degrees. Where no flange 82 is provided, the height of the silo is preferably about 0.254 cm greater than the depth of the recess 50 and the passageway portion 90 of the silo is compressed by about 0.127 cm.

The modular embodiment of the insert 52 will now be described with reference to Figures 7 to 10. A modular insert 100 for the plug connector 14 comprises two 3-position high voltage insulating insert modules 102 and 104, respectively, each defining three parallel silo receiving recesses 50' and their associated passageways 92' which are identical with the recesses 50 and passageways 92, respectively, described above. In the module 102, the centre recess 50' and its associated passageway 92' are offset from those on either side thereof whereby the module 102 defines on one side thereof a central, generally semicircular cross section, longitudinal arcuate rib 106 and on the opposite side thereof and opposite thereto, a longitudinal channel 108. The channel 108 is centrally interrupted by an external, transverse half flange portion 62' which extends above

said opposite side of the insert module 102. In the modul 104, a central recess 50' and its associated passageway 92' are similarly offset from those on either side thereof, whereby the module 104 defines on one side thereof a central, longitudinal, substantially semi-circular cross section, uninterrupted, channel 110, which is complimentary with the rib 106 of the module 102, and on the other side thereof a central longitudinal rib 112. The side of the module 104 opposite to that defining the channel 110 is surrounded by an external transverse, half flange portion 62''. The modules 102 and 104 can be nested together to provide the insert 100 by engaging the rib 106 of the module 102 in the channel 110 of the module 104. As shown in Figures 9 and 10, the two half flange portions 62' and 62'' cooperate to provide a flange portion which is equivalent to the flange portion 62 of the insert 52 and serves the same purpose thereas. The insert of the socket connector 12 may be similarly comprised of nested modules, and each insert may comprise more than two modules, according to convenience. The modular construction of the inserts allows high voltage cables to be assembled in cable harnesses each comprising a respective insert or inserts and cable harnesses, thus facilitating repair and replacement of the inserts.

The module retention clips 65 mentioned above, and the construction of the housing assemblies will now be described with reference to Figures 11 to 16.

Each retention clip 65 comprises a spring metal body 114, in the form of a loop, having, before its application the housing assembly 18, or 32, as the case may be, spaced free ends 116 shown in Figure 13. The body 114 is formed with alternating external axial nodes 118 and troughs 120 so that it conforms to the configuration of the respective opening 46 or 48 when the clip 65 has been assembled therein. The locking lances 67 project

obliquely radially inwardly of the clip 65 from the nodes 118.

As shown in Figure 11, the housing assembly 18 comprises a front section 122 and a rear section 124 which can be assembled together by screw means described below to define the through opening 46. Radially outwardly of the opening 46, the sections 122 and 124 define respective aligned bores 126 and 130 for receiving the socket terminals 20. The clip 65 is received in the housing section 124 to lie against a forwardly facing annular shoulder 134 therein, which restrains rearward movement of the clip 65 when the insert 54 is introduced into the opening 46 from the rear open end of the housing assembly 18. When the clip 65 is being inserted into the opening 46, the assembler constricts the clip 65 so that its free ends 116 are brought together, whereby the clip 65 engages resiliently against a radially inner wall 132 of the housing section 124. With the housing assembly 18 assembled to the shell 16, the insert 54 (or an equivalent modular insert) is then inserted into the opening 46 from the rear, with the silos 40 leading, until the latches 67 snap into engagement with the flange portion 62 of the insert 54. Figure 16 shows the leading, and working, end portion of an insert extraction tool 134 which, like the clip 65, is made of a spring metal to present nodes 135 corresponding to the nodes 118 of the clip 65. The tool 134 is in the form of a loop with spaced free ends 136. In order to extract the insert 54 from the housing assembly 18, the tool 134 is placed around the cables 105 which extend from the rear of the insert 54, and is introduced into the enlarged rear part of the opening 46 so that the nodes 135 deflect the latches 67 of the clip 65 and thereby disengage them from the flange section 62 of the insert so that it can be withdrawn rearwardly from the housing assembly 18 for repair or replacement.

The housing assembly 32 comprises a front housing section 138, a rear housing section 140 and a spacer section 142, which can be secured together by screw means described below to define the opening 48 and the
5 respective of passageways 38 for the pin contacts mentioned above. The front housing section 138 has an internal annular flange 156 presenting a rearwardly directed shoulder 158 for abutment with the respective clip 65 to restrain forward movement thereof. The clip 65
10 resiliently engages against the inner wall of the spacer 142 in the same way as the clip 65 of the housing assembly 18 resiliently engages the wall 132. The insert 52 (or a modular version thereof) is inserted through the opening 48 from the rear end thereof so that the locking lances 67
15 of the clip 56 snap into engagement with the flange portion 62 of the insert 52. As explained below, the forward part of the shell 30, with the housing assembly 32 therein, can be removed from the plug connector 14 to allow the tool 134 to be placed round the cables 106 and
20 introduced through the rear of the opening 48 to deflect the locking lances 67 from the flange portion 62 of the insert 52 to enable its removal rearwardly of the housing assembly 32 for repair or replacement.

As will be apparent from Figures 1 and 17, the
25 receptacle connector 12 and the plug connector 14 are secured together in mating relationship by the inter-engagement of a screw thread 159 at the forward end of the connector 12 with internal threads (not shown) in a ring 161 disposed at a position back from the forward end of
30 the connector 14. When mated, the connectors 12 and 14 can be rapidly released from each other, in an emergency situation, for example, where a breakaway connector assembly 10 is in use for the supply of the power and data through the helmet of an aircraft pilot, and the pilot is
35 obliged to eject from the aircraft. To allow for such

emergency release of the connectors 12 and 14 the plug connector 14 has a lanyard 160, which, at the time of said emergency situation, is attached to the pilot, the receptacle connector 12 being attached to the aircraft by means of a flange 163. When the lanyard 160 is pulled, a breakaway mechanism (not shown) in the plug connector 14 is operated, rapidly to free the connector 14 from the connector 12. Since the breakaway mechanism is described in a detail in GB-A-2,236,221 and in US-A-5,080,600, the disclosures of which are incorporated herein by reference, the breakaway mechanism will be described here only in outline. Briefly stated, the connector 14 includes a locking ring assembly comprising a forward locking ring, a centre stop ring and a rear locking ring. The lanyard 160 is fixed to the connector 14 and extends through a groove in the centre stop ring. Tension on the lanyard 160 produces a camming effect between the lanyard 160 and the stop ring so that the stop ring rotates, thereby unscrewing the connector 14 from the connector 12.

As shown in Figure 17, the housing sections of the housing assembly 32 are secured together by means of screw fasteners 164 (one of which is shown) which extend through respective bores 146 and 150 (Figure 15) in the housing assembly 32. The screw fasteners 164 each comprise a socket head screw and a washer and serve to connect the assembly 14 and the forward part of the shell 30 to the remainder of the connector 14. The housing assembly 32 and the front part of the shell 30 are thereby provided as a removable unit 162 which can be detached by unscrewing the screws and removed from the remainder of the connector 14 as shown in Figure 18. This enables the insert 52 to be removed from the housing assembly 32 in the manner described above. The housing sections of the housing assembly 18 are secured together by screw fasteners 166 and are secured thereby to the remainder of the connector

12. The fasteners 166 extend through bores 168 and 170
(Figure 2) of the housing assembly 12. The housing
assembly 18 does not need to be removed from the remainder
of the connector 12 in order to remove the insert 54,
5 because the rear end of the connector 12 is open as
mentioned above.

CLAIMS

1. An electrical connector housing assembly having a forward mating face and a rear face opposite thereto, and defining an opening extending between, and opening into, each of said faces; an insert for introduction into said opening in an insertion direction and containing at least one electrical terminal extending through the insert and having a mating forward section and a rear section for connection an electrical conductor; and a retention clip dimensioned to surround said insert and resiliently to engage the wall of the opening; the housing assembly defining a shoulder in said opening for restraining movement of the retention clip in the insertion direction, and the retention clip having internally projecting locking lances each for engaging a flange on the insert to retain it in the opening and each being deflectable to release the insert for withdrawal from the opening.
2. A housing assembly as claimed in Claim 1, wherein the retention clip is in the form of a loop having free ends and is compressible to allow its reception in the opening, each locking lance extending obliquely in the insertion direction when the clip is engaged with the shoulder.
3. A housing assembly as claimed in Claim 1 or 2, wherein the housing assembly comprises a plurality of housing sections each defining a respective part of the opening and having bores receiving fasteners to secure the housing sections together in juxtaposed abutting relationship.
4. A housing assembly as claimed in Claim 3, wherein one of the housing sections defines and enlarged part of the opening and a part of the opening of smaller cross section

than the enlarged part, thereby defining the shoulder, which faces rearwardly.

5 5. A housing assembly as claimed in Claim 3, wherein the housing assembly comprises forward and rearward housing sections and a spacer section therebetween, the clip being received in the spacer section and the forward housing section presenting said shoulder.

10 6. A housing assembly as claimed in any one of the preceding claims, when secured in an electrical connector, wherein the housing assembly is detachable from the connector as a single unit, to allow access to the locking lances of the retention clip to enable release of the
15 insert from the housing assembly.

 7. A housing assembly as claimed in any one of the preceding claims, wherein the insert comprises a plurality of insert modules nested together.

20 8. A housing assembly as claimed in claim 7, wherein the insert comprises a pair of insert modules one of which defines a rib extending longitudinally of the module and the other of which defines a channel for receiving the
25 rib, each module having a substantially longitudinally central flange portion, said flange portions cooperating to define said flange when the modules are nested together.

30 9. A housing assembly as claimed in claim 8, wherein each module contains three electrical terminals, a central one of which is offset from the two remaining terminals.

35 10. An electrical connector housing assembly
 substantially as hereinbefore described with reference to

the accompanying drawings.



Application No: GB 9605842.5
Claims searched: 1 to 10

Examiner: F J Fee
Date of search: 17 May 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.O): H2E [EDCK, EDLC, E140]

Int CI (Ed.6): H01R

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 1500102 [ITT]	1. 2. 6

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.

& Member of the same patent family

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